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HARNESS, DICKEY & PIERCE, P.L.C.

Attorneys and Counselors
11730 Plaza America Drive, Suite 600,
Reston, Virginia 20190
P.O. Box 8910, Reston, Virginia 20195
Phone: (703) 668-8000
Fax: (703) 668-8200

Fax

To:	Examiner Cole	From:	Daniel Podhajny
	U.S. Patent & Trademark Office		

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Pursuant to our conversation today, enclosed is the revised appeal brief for Application Serial No. 09/764,072 with a signature. Should you have any questions or require anything further, please contact Mr. Yacura's associate, Daniel Podhajny at 703-668-8028.

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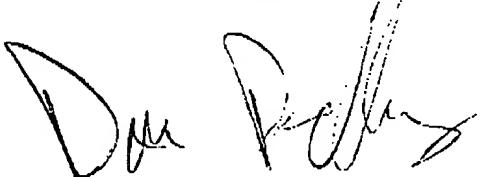
PATENT

IN THE U.S. PATENT AND TRADEMARK OFFICE

Appellants:	Hisham S. Abdel-Ghaffer
Application No.:	09/764,072
Art Unit:	2115
Filed:	January 19, 2001
Examiner:	Mark A. Connolly
For:	A METHOD OF DETERMINING A TIME OFFSET ESTIMATE BETWEEN A CENTRAL NODE AND A SECONDARY NODE

Attorney Docket No.: 29250-000502/US

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July 6, 2006

<u>APPELLANTS' REVISED BRIEF ON APPEAL UNDER 37 C.F.R. §41.37</u>

Sir:

In accordance with the provisions of 37 C.F.R. §41.37, Appellants submit the following:

I. <u>REAL PARTY IN INTEREST</u>

The real party in interest in this appeal is Lucent Technologies.

II. <u>RELATED APPEALS AND INTERFERENCES</u>

There are no known appeals or interferences that will affect, be directly affected by, or have a bearing on the Board's decision in this Appeal.

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III.   STATUS OF CLAIMS

Claims 1-11 are pending in the application, with claims 1 and 11 being written in independent form.

Claims 1-4, 7 and 11 remain finally rejected under 35 U.S.C. § 102 (b) as being anticipated by Premerlani (US Patent No. 5,958,060).

Claims 5-6 and 8-10 remain finally rejected under 35 U.S.C. § 103 (a) as being unpatentable over Premerlani in view of Thornberg (US Patent No. 5,757,772).

Claims 1-11 are being appealed.

IV.   STATUS OF AMENDMENTS

No Amendments have been entered.

V.   SUMMARY OF CLAIMED SUBJECT MATTER

The claimed invention is directed to a method of determining a time offset estimate between a central node and a secondary node. Clock synchronization is a problem in distributed networks.[1] If different nodes in the distributed network are not synchronized (i.e., timing references at the nodes are not identical), it may be difficult to synchronize both of the nodes to a common reference (e.g., Coordinated Universal Time (UTC)).[2]

The inventors teach a method of determining a time offset estimate between a central node and a secondary node. A periodic timer includes a counter which starts at an initial value (e.g., 0) and counts up at equal increments until the counter reaches a threshold (e.g., 4095), at which point a next increment resets the counter to the initial value, where the resetting of the counter is referred to as a time wraparound.[3] Thus, at any given value of the periodic timer, the periodic timer will arrive again at the given number after a number of increments or counts equal to the threshold. Periodic timing will now be further discussed with respect to Figure 2.

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[1] See Page 1, lines 11-12 of the Specification.
[2] See Page 1, lines 13-17 of the Specification.
[3] See Page 3, lines 5-19 of the Specification.

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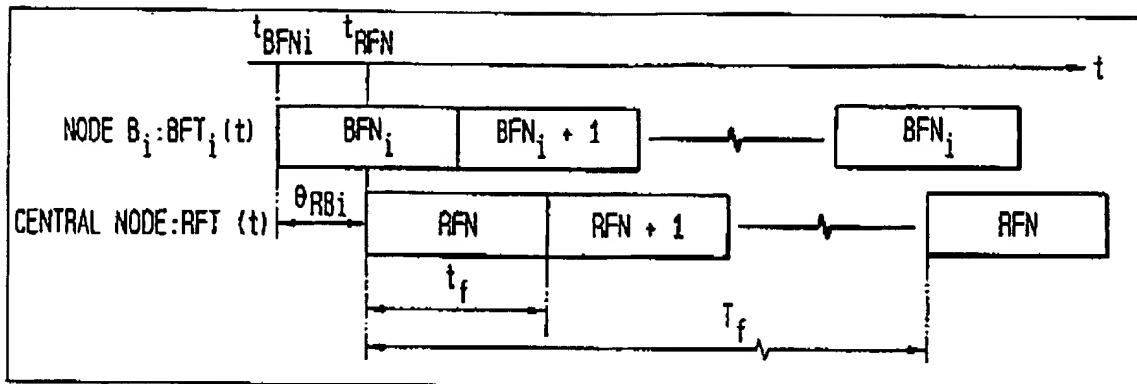
Figure 2 of the Present Invention

In the example embodiment of Figure 2 (reproduced above), the local timings of the central node R and the secondary nodes B_i's are periodic in modulo T_f format and the associated central node Frame Number (RFN) and node B_i Frame Number (BFN$_i$) are also periodic integers in modulo T_f format (i.e., RFN, BFN$_i$ = 0, 1, ..., 4095 in 3GPP).[4] Accordingly, the central frame node time RFT and the node B_i frame time BFT$_i$ hold to the following expressions:

$$RFT\ (t + T_f) = RFT\ (t)$$

$$BFT_i\ (t + T_f) = BFT_i(t)[5]$$

As disclosed on page 5 of the Specification, a time offset between a central node and a secondary node may arise because of uncoordinated system start times, intentional or accidental system restarts and/or a frequency drift during normal operation.[6] The time offset between the central node and the secondary node may be less accurate if a time wraparound occurs at the periodic counter at either the central node or the secondary node.[7]

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[4] See Page 3, lines 20-23 of the Specification.
[5] See Equations (1) and (2) on Page 3 of the Specification.
[6] See Page 5, lines 13-26 of the Specification.
[7] See Page 2, lines 3-12 of the Specification.

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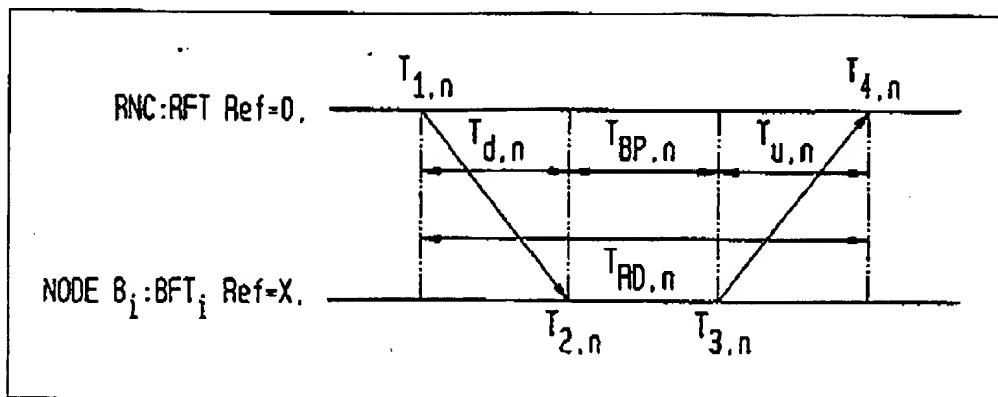
Figure 3 of the Present Invention

The method of estimating the time offset between the central node R and a secondary node B according to the claimed invention operates based on timing information measured at the central node R and the secondary node B.[8] One method for obtaining this timing information involves the sending of control frames between the central node R and the secondary node B.[9] As shown in Figure 3 (reproduced above) and described in steps S15-S30 of Figure 4A, the central node R sends a downlink (DL) node sync control frame stamped by RFT send epoch $\{T_{1,n}\}$.[10] Namely, the time $T_{1,n}$ is the local time at the central node R when the control frame is sent to the secondary node B.[11] The secondary node B receives that frame at BFT_i receive epoch $T_{2,n}$.[12] After certain secondary node B processing time T_{BP}, the secondary node B sends an uplink (UL) node sync control frame at BFT_i epoch $T_{3,n}$, where this frame is stamped by $\{T_{1,n}, T_{2,n}, T_{3,n}\}$.[13] Here, the times $T_{2,n}$ and $T_{3,n}$ are the local times measured at the secondary node B. When the central node R receives the UL node sync frame, it records the RFT receive epoch $T_{4,n}$.[14]

Once the central node R receives each of the times $t_{1,n} - t_{4,n}$, a time wraparound adjustment (e.g., a conversion from a periodic to a continuous time scale) is executed (See step

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[8] See Page 6, lines 14-17 of the Specification.
[9] See Page 6, lines 17-18 of the Specification.
[10] See Page 6, lines 19-27 of the Specification.
[11] *Id.*
[12] *Id.*
[13] *Id.*
[14] See Page 6, lines 20-27 of the Specification.

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S35 in Figure 4A).[15] The time wraparound adjustment performed by the central node is

illustrated in detail in Figure 5 (reproduced below).
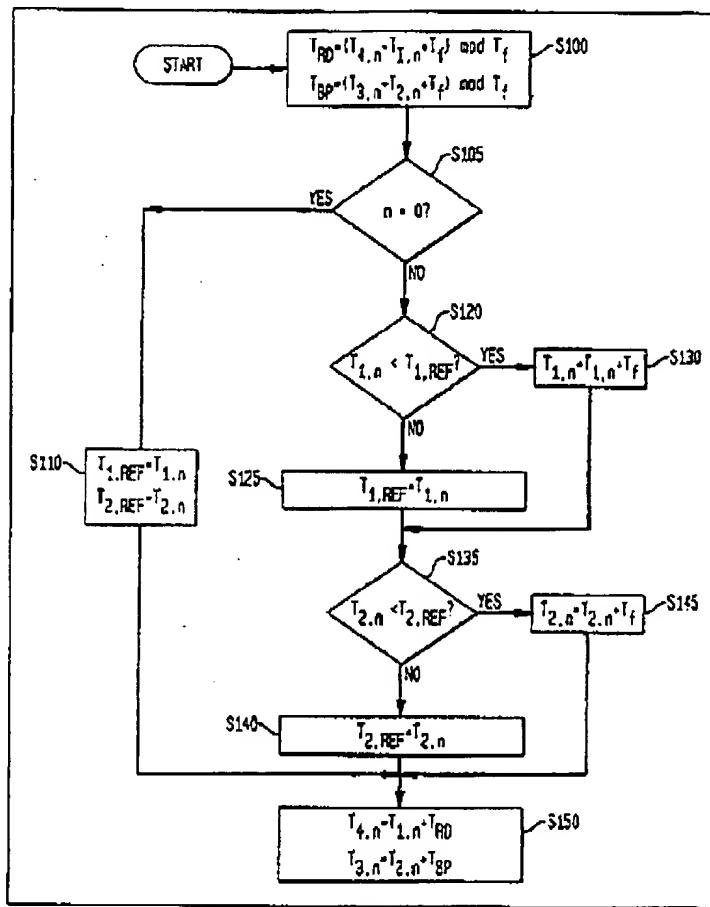
Figure 5 of the Present Invention

As shown in Fig. 5, in step S100, the central node R calculates the total round trip delay

T_{RD} and the secondary node processing time T_{BP}, compensated for time wraparound by use of

the "mod" calculation.[16] Subsequently, in step S105, the central node R determines if the timing

information represents a first sample.[17] If so, then in step S110, a reference first send time $T_{1,REF}$

and a reference first receive time $T_{2,REF}$ are set equal to the first send time $T_{1,n}$ and the first

receive time $T_{2,n}$, respectively.[18]

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[15] See Page 8, lines 17-19 of the Specification.
[16] See Equations (8) and (9) on Page 7 of the Specification and Page 8, lines 19-22 of the Specification.
[17] See Page 8, lines 22-23 of the Specification.
[18] See Page 8, lines 23-25 of the Specification.

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　　　　However, processing proceeds to step S120 if, in step S105, the sample count n does not equal zero.[19] In step S120, the central node R determines if the first send time $T_{1,n}$ is less than the reference first send time $T_{1,REF}$.[20] If so, then time wraparound has occurred at the central node R, and in step S130, the first send time $T_{1,n}$ is changed to $T_{1,n} + T_r$.[21] This operation converts the first send time $T_{1,n}$ from a periodic time scale to a continuous time scale.[22] If the central node R does not determine that the first send time $T_{1,n}$ is less than the reference first send time $T_{1,REF}$ in step S120, then processing proceeds to step S125.[23] In step S125, the central node R sets the reference first send time $T_{1,REF}$ equal to the first send time $T_{1,n}$.[24]

　　　　After step S130 or step S125, processing proceeds to step S135.[25] In step S135 the central node R determines if the first receive time $T_{2,n}$ is less than the reference first receive time $T_{2,REF}$.[26] If so, then time wraparound has occurred at the secondary node B, and in step S145, the first receive time $T_{2,n}$ is changed to $T_{2,n} + T_r$.[27] This operation converts the first receive time $T_{2,n}$ from a periodic time scale to a continuous time scale.[28] If the central node R does not determine that the first receive time $T_{2,n}$ is less than the reference first receive time $T_{2,REF}$ in step S135, then processing proceeds to step S140.[29] In step S140, the central node R sets the reference first receive time $T_{2,REF}$ equal to the first send time $T_{2,n}$.[30]

　　　　After step S140 or step S145, processing proceeds to step S150.[31] In step S150, the second receive time $T_{4,n}$ is set equal to the first send time $T_{1,n}$ plus the total round-trip delay T_{RD} and the second send time $T_{3,n}$ is set equal to the first receive time $T_{2,n}$ plus the secondary node processing time T_{BP}.[32] Because the first send time $T_{1,n}$ and the first receive time $T_{2,n}$ have been

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[19] See Page 8, lines 26-27 of the Specification.
[20] See Page 8, lines 27-28 of the Specification.
[21] See Page 8, lines 28-29 of the Specification.
[22] See Page 8, lines 29-31 of the Specification.
[23] See Page 8, lines 31-32 of the Specification.
[24] See Page 8, line 32 to Page 9, line 2 of the Specification.
[25] See Page 9, line 3 of the Specification.
[26] See Page 9, lines 3-5 of the Specification.
[27] See Page 9, lines 5-6 of the Specification.
[28] See Page 9, lines 6-7 of the Specification.
[29] See Page 9, lines 7-9 of the Specification.
[30] See Page 9, lines 9-11 of the Specification.
[31] See Page 9, line 12 of the Specification.
[32] See Page 9, lines 12-15 of the Specification.

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compensated for time wraparound, setting the second send time $T_{3,n}$ and the second receive time $T_{4,n}$ in this manner likewise compensates for time wraparound.[33]

After the time wraparound adjustment, as above-described with respect to Figure 5 is executed, uplink $T_{u,n}$ and downlink $T_{u,n}$ delay indicators are determined according to steps S40-S55 in Figure 4A as shown by equations (10) and (11) reproduced below:

$$\tau_{D,n} = (T_{2,n} - T_{1,n}) = T_{D,n} + X_i \qquad (10)$$

$$\tau_{U,n} = (T_{4,n} - T_{3,n}) = T_{U,n} - X_i \qquad (11)$$

where x_i represents the time offset.[34]

After having obtained a number of uplink and downlink delay indicator samples (see step S50 in Figure 4B which requires N samples before proceeding)[35], a minimum of each of the uplink and downlink delay indicators is determined in step S55 of Figure 4B.[36] Then , the time offset X_i is determined according to equation 13 below in step S60 of Figure 4B:

$$\hat{X}_i = \frac{1}{2}\left[\tau_{D,\,min} - \tau_{U,\,min}\right] \quad , \qquad \{\text{adjusted within } [-T_f/2,\ T_f/2) \qquad (13)\ [37]$$

VI.   GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Appellants seek the Board's review of the rejection of claims 1-4, 7 and 11 under 35 U.S.C. § 102 (b) as being anticipated by Premerlani and claims 5-6 and 8-10 under 35 U.S.C. § 103 (a) as being unpatentable over Premerlani in view of Thornberg.

VII.   ARGUMENTS

A.   **Appellants traverse the rejection of claims 1-4, 7 and 11 under 35 U.S.C. § 102(b) as being anticipated by Premerlani.**

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[33] See Page 9, lines 15-18 of the Specification.
[34] See Page 9, lines 19-23 of the Specification and equations (10) and (11) on page 7 of the Specification.
[35] See Page 9, lines 22-25 of the Specification.
[36] See Page 9, lines 25-27 of the Specification.
[37] See Page 9, line 27 – Page 10, line 5 of the Specification.

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Claims 1 and 11 are argued separately below with claims 1-4 and 7 rising and falling together.

i)   Claim 1

In the final Office Action dated December 15, 2004, the Examiner relies substantially upon column 6, lines 14-34 of Premerlani in rejecting independent claim 1.[38] In the cited section, Premerlani discusses round trip delay. Premerlani discloses that round trip delay may be calculated by subtracting the measured delay between a first terminal and a second terminal from the measured delay between the second terminal and the first terminal.[39] The clock offset is determined by adding the two delays between the first and second terminals and dividing by two.[40] Premerlani states that "the clock offset can be positive or negative if time stamps are unsigned numbers that wrap around".[41] Premerlani discloses that if a rollover or wraparound of any one of the time stamps occurs, a predetermined number may either be added or subtracted to/from the round trip delay and one-half the predetermined number may either be added or subtracted to/from the clock offset.[42]

Independent claim 1 recites "converting the received downlink and uplink timing information to a continuous time scale". Premerlani does not disclose converting the received downlink and uplink timing information to a continuous time scale. Rather, as discussed above, Premerlani compensates for time wraparound by subtracting or adding a predetermined number from the roundtrip delay.[43] The roundtrip delay is calculated using unconverted downlink and uplink timing values.[44] If Premerlani were to convert the received downlink and uplink timing information into a continuous time scale, no adjustment to the round trip delay would be necessary.

Independent claim 1 further recites "determining a time offset estimate between the central node and the secondary node based on the converted downlink and uplink timing information". Since independent claim 1 recites that the time offset estimate is based on the

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[38] See Pages 2-3 of the December 15, 2004 Final Office Action.
[39] See Column 6, lines 13-34 of Premerlani.
[40] Id.
[41] Id.
[42] Id.
[43] Id.
[44] Id.

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converted downlink and uplink timing information, the time offset estimate does not require the above-described adjustment with the predetermined number of Premerlani.

As discussed above, the predetermined number in Premerlani may either be subtracted or added to the final calculated round trip delay or the clock offset, which indicates that the downlink and uplink timing information (the respective measured delays between the first and second terminals) is performed after the determination of the round trip delay and the clock offset. In contrast, independent claim 1 recites determining the time offset estimate "based on the converted downlink and uplink timing information". Thus, according to the claimed invention, no subtraction to compensate for time wraparound would be executed on the determined time offset estimate because the uplink and downlink timing information, used to calculate the time offset estimate, is already in the continuous time domain.

Therefore, Applicant respectfully submits that Premerlani cannot disclose or suggest determining time offset "based on the converted downlink and uplink timing information" as recited in independent claim 1. Rather, Premerlani discloses calculating the round trip delay and the clock offset with periodic time stamps and then performing a compensation for rollover.

As demonstrated above, independent claim 1 is not anticipated or rendered obvious to one skilled in the art by Premerlani.

ii)   Claim 11

As discussed above with respect to independent claim 1, Premerlani discloses calculating the round trip delay and the clock offset using only periodic time stamps.[45] After the round trip delay and the clock offset are calculated, Premerlani discloses adjusting the round trip delay for time wraparound, not the downlink and uplink timing information.[46]

Thus, Premerlani cannot disclose or suggest "adjusting the received downlink and uplink timing information for time wraparound" as recited in independent claim 11. Likewise, it follows that Premerlani cannot disclose or suggest determining a time offset estimate "based on the adjusted downlink and uplink timing information" as recited in independent claim 11. Rather, as discussed above with respect to independent claim 1, it appears that the disclosure of

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[45] Id.
[46] Id.

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Premerlani teaches calculating the round trip delay and the clock offset using only time stamps unadjusted for time wraparound and then executing a compensation for execution a time wraparound adjustment to the calculated round trip delay.

As demonstrated above, independent claim 11 is not anticipated or rendered obvious to one skilled in the art by Premerlani.

B.   Appellants Traverse the Rejection of Claims 5-6 and 8-10 under 35 U.S.C. §103 (a) as being unpatentable over Premerlani in view of Thornberg

As discussed above, Premerlani does not anticipate or render claim 1 as obvious to one skilled in the art. However, the Examiner alleges that "Thornberg teaches calculating a plurality of uplink and downlink delays in order to find an average uplink and downlink delay".[47]

Thornberg discloses a method of packet switched radio channel traffic supervision.[48] Thornberg relates to estimating either the uplink or the downlink average data packet delays in a communications network.[49] Thornberg, however, discloses nothing related to converting the periodic delay into a continuous time scale.[50] Thus, even if the Examiner is correct in that "Thornberg teaches calculating a plurality of uplink and downlink delays in order to find an average uplink and downlink delay", Applicant respectfully submits that Thornberg is similarly deficient as is Premerlani as discussed above with respect to independent claim 1.[51] Therefore, Premerlani in view of Thornberg cannot render claim 1 as obvious to one skilled in the art.

As such, claims 5-6 and 8-10, dependent upon independent claim 1 are likewise allowable over the Premerlani in view of Thornberg at least for the reasons given above with respect to independent claim.

VIII. CONCLUSION

Appellants respectfully request the Board to reverse the Examiner's anticipation and/or obviousness rejection of claims 1-11.

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[47] See page 4 of the December 15, 2004 Final Office Action.
[48] See Abstract of Thornberg.
[49] Id.
[50] Id.
[51] See page 4 of the December 15, 2004 Final Office Action.

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The Commissioner is authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

HARNESS, DICKEY & PIERCE, P.L.C.

By: _____ #57,687
Gary D. Yacura, Reg. No. 35,416
P.O. Box 8910
Reston, Virginia 20195
(703) 668-8000

GDY/DAP/cdw

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IX.   CLAIMS APPENDIX

Claims 1-11 on Appeal

1.   (Original)   A method of determining a time offset estimate between a central node and a secondary node, comprising:

receiving, at a central node, downlink and uplink timing information from a secondary node, the downlink and uplink timing information based on a periodic timing scale, the downlink timing information representing timing information for communication from the central node to the secondary node and the uplink information representing timing information for communication from the secondary node to the central node;

converting the received downlink and uplink timing information to a continuous time scale; and

determining a time offset estimate between the central node and the secondary node based on the converted downlink and uplink timing information.

2.   (Original)   The method of claim 1, wherein the downlink information includes a first time measured at the central node of sending a downlink frame to the secondary node and a second time measured at the secondary node of receiving the downlink frame, and the uplink information includes a third time measured at the secondary node of sending an uplink frame.

3.   (Original)   The method of claim 2, further comprising:
measuring, at the central node, a fourth time of receiving the uplink frame; and wherein the converting step converts the first, second, third and fourth times to a continuous time scale.

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4.   (Original)   The method of claim 3, wherein the determining step comprises:

determining uplink and downlink delay indicators based on the converted first, second, third and fourth times; and

calculating the time offset estimate based on the uplink and downlink delay indicators.

5.   (Original)   The method of claim 4, wherein

the determining uplink and downlink delay indicators step is performed for a plurality of first, second, third and fourth time sets; and

the calculating step calculates the time offset estimate based on the plurality of uplink and downlink delay indicators.

6.   (Original)   The method of claim 5, wherein the calculating step comprises:

determining a minimum uplink delay indicator and a minimum downlink delay indicator from the plurality of uplink and downlink delay indicators; and

calculating the time offset estimate based on the minimum downlink delay indicator and the minimum uplink delay indicator.

7.   (Original)   The method of claim 1, further comprising:

sending a downlink frame to the secondary node, the downlink frame including a first time measured at the central node indicating when the downlink frame is sent; and wherein

the receiving step receives an uplink frame at the central node, the uplink frame includes the first time, a second time measured at the secondary node of receiving the downlink frame, a third time measured at the secondary node of sending the uplink frame.

8.   (Original)   The method of claim 1, further comprising:

setting a timer at a start of the method; and

stopping the method if the timer times out.

9.   (Original)   The method of claim 1, further comprising:

compensating the time offset estimate for DC bias errors.

10.   (Original)   The method of claim 1, wherein the central node is a radio network

controller.

11.   (Original)   A method of determining a time offset estimate between a central

node and a secondary node, comprising:

receiving, at a central node, downlink and uplink timing information from a secondary

node, the downlink and uplink timing information based on a periodic timing scale, the downlink

timing information representing timing information for communication from the central node to

the secondary node and the uplink information representing timing information for

communication from the secondary node to the central node;

adjusting the received downlink and uplink timing information for time wraparound; and

determining a time offset estimate between the central node and the secondary node

based on the adjusted downlink and uplink timing information.

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X. EVIDENCE APPENDIX

No evidence has been submitted pursuant to §§ 1.130, 1.131, or 1.132 of this title, nor has any other evidence been entered by the examiner and relied upon by appellant in the appeal. As such, Appellants have omitted the Evidence appendix under 37 C.F.R. § 41.37(c)(1)(ix).

XI. RELATED PROCEEDINGS APPENDIX

Presently, there are no related proceedings pursuant to 37 C.F.R. § 41.37(c)(1)(ii).